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Heraclitus, Change and Objective Contradictions in Aristotle's *Metaphysics* Γ

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Abstract: In *Metaphysics* Γ, Aristotle argues against those who seem to accept contradictions. He distinguishes between the Sophists, who deny the principle of non-contradiction through arguments, and the Natural Philosophers, whose physical investigations lead to the acceptance of objective contradictions. Heraclitus' name appears throughout the discussion. Usually, he is associated with the discussion against the Sophists. In this paper, I explore how the discussion with the Natural Philosophers may illuminate both the interpretation of Heraclitus by Aristotle and Heraclitus' own worldview. To refute the Natural Philosophers, Aristotle proposes a general reconstruction of their reasoning. Roughly, relying on sensory evidence (A1), they see that the same thing changes from one opposite to another (A2). Such a change appears to characterize a generation out of non-being, which a Natural Philosopher does not accept (A3). To solve the problem, despite their different worldviews, Natural Philosophers hint at a state in which opposites co-occur, characterizing an objective contradiction (C). Looking at the discussion in *Metaphysics* Γ and Heraclitus fragments, sections 1–3 show how assumptions A1, A2, and A3 easily apply to Heraclitus. The case of the conclusion is more challenging. In the case of the Pluralists, the co-existence of opposites characterizes a state in which there is no generation. Such a view does not fit Heraclitus' mobilism. To argue that Aristotle's argument is general enough to encompass dynamic views, I examine his problematization of accepting the change of change in *Metaphysics* K and *Physics* V. There, after re-stating several points that appear in *Metaphysics* Γ, Aristotle argues that accepting the becoming of another becoming leads to a state of contradiction in which the becoming is perishing. Heraclitus' B8, cited in *Nicomachean Ethics*, gives evidence that, for Aristotle, Heraclitus puts a process at the origin of an opposite process. Moreover, after examining the expression 'living the death/dying the life' in B62, I argue that Heraclitus was aware that his worldview implied a dynamic objective con-

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tradition. Finally, an analysis of elemental changes in B36 proves that accepting objective contradictions does not make Heraclitus' worldview less attractive.

Keywords: Heraclitus, Principle of Non-contradiction, Aristotle, *Metaphysics* Γ, Process Philosophy

Introduction

In *Metaphysics* Γ.3, Aristotle introduces the principle of non-contradiction (PNC). He calls it the most certain principle and adds that it would be impossible not to follow it (1005^b22–25). Despite that, he reckons that some thinkers are committed to contradictions. For instance, that the same thing is and is not 'is what some say that Heraclitus said'. In chapters 4 to 7, he presents several arguments against these thinkers. They may be divided into two main groups, the Natural Philosophers and the Sophists.

Given this division, we stumble across a problem concerning the references to Heraclitus in 1005^b, 1010^a, and 1012^a. There are reasons to associate him with both groups. Plato's *Theaetetus*, where Heraclitus is associated with Protagoras, is one of the main sources for the discussion in *Metaphysics* Γ. In *Metaphysics* A, however, Heraclitus is treated as a natural philosopher. Usually, scholars find a stronger association with Heraclitus in Aristotle's discussion with the Sophists. Nevertheless, since the sophists may have developed their views based on some early findings of natural philosophy, and since Aristotle saw Heraclitus as a natural philosopher, one might want to find a unitary reading. Rapp (2017), p. 418 takes this route. Nevertheless, he also stresses that despite recognizing Heraclitus as a natural philosopher, Aristotle was more suspicious of the derivable consequences of a Heraclitean worldview when used eristically by the sophists.

In the following, I take the other route and dive deeper into what might be Aristotle's critique of Heraclitus' natural philosophy. Sections 1–3 deal with the assumptions in Aristotle's reconstruction of the reasoning that led the Natural Philosophers to accept contradictory states of affairs. They are easily applicable to what we find in Heraclitus' fragments. The case of the conclusion is treated in section 4 and proves to be more challenging. According to Aristotle, the contradictions accepted by the Natural Philosophers consist in postulating co-existing opposites. Most of the names he provides as illustrations are Pluralists like Empedocles, Democritus, and Anaxagoras. They share the reduction of generation to non-transformative processes such as separation and aggregation. Once there is no generation, an opposite that became apparent must have existed before while its opposite was apparent. The situation characterizes a contradiction. However,

transformation is an undeniable aspect of Heraclitus' worldview. This difference demands further investigation to establish how co-existing contraries might obtain in a Heraclitean worldview.

Section 5 explores what might be the missing piece for understanding the general reconstruction of the Natural Philosophers' reasoning in the case of Heraclitus. While examining the problem of change of change, Aristotle argues that accepting the becoming of another becoming leads to a contradiction. I will then try to show that this problem fits Aristotle's reading of Heraclitus based on Aristotle's citation of Heraclitus' B8. The problem of contradiction in a dynamic setup would thus justify the inclusion of Heraclitus in the argument against the Natural Philosophers. During the discussion, I analyse fragments B88, B62, and B36 in order to show that Aristotle's reading is not far from Heraclitus' worldview.

Aristotle's reconstruction of Natural Philosophers' reasoning

For Aristotle, the PNC is the most certain of the principles (1006^a6).¹ Yet, some philosophers seem to deny PNC. The principle is so fundamental that it is not provable. Thus, to convince the PNC deniers, Aristotle engages in different refutation strategies adapted to the type of opponent, which we as interpreters can divide into two groups:²

The *Natural Philosophers* encompass those who, when faced with legitimate difficulties in their investigation of nature, are led to the postulation of a theory in which contradictory states of affairs obtain (1009^a19–21). The immediate names associated with this group are Democritus and Anaxagoras.

The *Sophists*, like Protagoras, offer arguments for the denial of PNC. The sophistic denial of the PNC can be thought of as the eristic approach according

¹ See Dancy (1975), pp. 3 and 7, who examines two ways PNC is not provable according to Aristotle. First, there is the cognitive priority: people make mistakes about what they do not know, but everyone knows the truth of PNC (1005^b11–14). Second, there is the logical priority: PNC is by nature the principle for all other axioms (1005^b32–34). Neither seems to apply to the Natural Philosophers.

² Examples of this recurring division are (I) physicists, namely, natural philosophers, and (II) those who lack education and require proof of everything (1006^a1); (I) Those who arrive at a denial of PNC out of *aporia* and (II) those who arrive at it by argument (*logos*) (1009^a19–21), assuming that one of the arguments would be to ask for a proof of PNC.

to which for any statement P, one can find a convincing argument either that the statement is not sufficiently proved or that the opposites statement non-P is equally defensible. In the discussion against the Sophists, Aristotle argues that accepting one case of P and non-P would lead to an attitude according to which anything can be said of anything that would render any discourse futile.

The approach of the Natural Philosopher should be distinguished from the sophistic denial of PNC. The investigation into the nature of things might find some phenomena for which the best explanation entails the occurrence of a specific type of contradictory state of affairs. Such occurrences are called true or objective contradictions. This position is not as absurd as that of the Sophists. If the primacy belongs to empirical data, and the goal is a precise description of nature, objective contradictions might be, at least, kept among the possible explanations. After all, that nature follows the rules of discourse or logic is a big assumption.³ Even for someone like Aristotle, who accepts such an assumption, it is clear that objective contradictions are circumscribed and do not make discourse futile. Thus, he deals with the Natural Philosophers differently.⁴

Since their problem arises from their investigation of nature, Aristotle proceeds by making them aware of what would be the methodological source of their mistake.⁵ To do so, he reconstructs the Natural Philosopher's reasoning in 1009a24–30:⁶

(A1) Natural Philosophers form their opinions from sensible phenomena.

(A2) They see contraries coming to be out of the same thing, and

³ Heraclitus' peculiar style indicates that he tries to change language to express the nature of things. The anti-cognate object in B62 might be an example (see section 5 below). In *Theaetetus* 183A–C, Plato suggests that Heracliteans will have to create a new language if they want to express their mobilist position.

⁴ Lukasiewicz (1971) proposed the now classical division between three versions of PNC. All of them occur in *Metaphysics* Γ: the ontological version (1005^b19–20), the logical one (1011^b13–14), and the psychological one (1005b13–14). For the present discussion, the problem is less the principle and more the occurrence of objective contradictions in nature. Accordingly, I use the version stated in the discussion with the Natural Philosophers. An objective contradiction is a sub-case of a denial of the ontological version of PNC.

⁵ In 1009^a17, Aristotle says that each opponent requires a different approach. He also says it is easy to show the mistake of those who err in reasoning (*dianoia*) like the Natural Philosophers. Accordingly, he spends more time arguing against the Sophists. This discussion received much more attention in the literature.

⁶ (A1) ἐλήλυθε δὲ τοῖς διαποροῦσιν αὕτη ἡ δόξα ἐκ τῶν αἰσθητῶν, ἡ μὲν τοῦ ἅμα τὰς ἀντιφάσεις καὶ τὰναντία ὑπάρχειν (A2) ὁρῶσιν ἐκ ταυτοῦ γιγνόμενα τὰναντία: (A3) εἰ οὖν μὴ ἐνδέχεται γίγνεσθαι τὸ μὴ ὄν, (C) προϋπῆρχεν ὁμοίως τὸ πρᾶγμα ἄμφω ὄν, ὥστερ καὶ ἄναξαγόρας μεμίχθαι πᾶν ἐν παντί φησι καὶ Δημόκριτος: καὶ γὰρ οὗτος τὸ κενὸν καὶ τὸ πλήρες ὁμοίως καθ' ὅτι οὐκ ὑπάρχειν μέρος, καίτοι τὸ μὲνδὸν τοῦτων εἶναι τὸ δὲ μὴ ὄν.

- (A3) unwilling to accept generation out of what is not,
they conclude that
- (C) both contraries must preexist in the thing, in the same way (*homoiôs*).⁷

Because of its generality, the reconstruction is likely to incur a simplification of the different doctrines treated together. The simplification might seem unfair when one considers the specificity of the doctrines of the different natural philosophers. Yet, at the general level supposed by the argument, it suffices that the assumptions fit what is common in the Natural Philosophers' attitude towards investigating nature and that the results arising from it imply a state of contradiction, despite the differences in each doctrine. Due to an established tradition of treating the Pluralists as philosophers who presented variations of a similar answer to Parmenides, it is easier to see Empedocles, Anaxagoras, and even Democritus as a group with a similar line of reasoning and conclusions. Nevertheless, sections 1–3 provide analyses of the claims and a comparison with groups of fragments from Heraclitus to argue that the assumptions are easily applicable to Heraclitus as well.

1 Unjustified generalization (A1)

The first assumption (A1) claims that knowledge by contact with sensible phenomena is the methodological source of the Natural Philosophers' reasoning mistakes.⁸ Aristotle repeatedly criticizes the presocratics for conflating thinking and perceiving.⁹ But even in the restricted context of the reconstruction above, the conflation cannot mean that knowing is reducible to perceiving.¹⁰ After all, the unwillingness to accept generation out of nothing (A3) is not based on perception. Moreover, Aristotle himself uses the sensible experience of movement as a truism for the existence of change.¹¹ If so, the use of sensory information is not a problem

⁷ Before the argument we find another formulation of the problematic conclusion: "The co-existence (*hama*) of contradictories (*antiphraseis*) and contraries (*enantia*)."

⁸ See Mourelatos (2008), ch. 10, who uses acquaintance to characterize the ordinary relation of having contact with people, places, and massive bodies such as the ocean.

⁹ See also 1009^b14–15 and *De anima* 427^a26–29

¹⁰ For a view that the accusation of conflating perceiving and thinking only means that, for the presocratics, thinking works like perceiving, see Lee (2005), p. 121.

¹¹ Ackrill (1997), p. 132 points out that in *Phys.* VIII.3 253^a32–^b6, Aristotle uses the sensible experience of movement as obvious proof that change exists.

per se, nor does the presocratics restrict their analysis to phenomena identified by the senses. As we are about to see in (A2), Aristotle indicates that the Natural Philosophers gather information from a type of natural phenomena and generalize it without justification.¹² In light of this, the implied critique of (A1) makes more sense if read as a case of unjustified generalization. Natural Philosophers use information gathered by the observation of a restricted type of occurrences to make sense of everything else, including what is unavailable to the senses.

This description fits Democritus' position, in which atoms are invisible but have visible properties such as weight and shape. It also suits Anaxagoras' thesis that everything is in everything, including hidden sensible or secondary qualities such as hot and cold or colours.¹³

Heraclitus' fragments provide hints that reason plays a crucial role in knowledge acquisition. Thus, reducing knowledge to perception does not fit his view as well. Some interpreters go as far as claiming that sensory information plays no role in knowledge acquisition to Heraclitus.¹⁴ Knowledge would come out of an exclusively self-immersive rational activity. The source for this interpretation lies in the critique of *polumathiê* read as the 'experience of many things' in B40.¹⁵ However, to do so, these interpreters have to explain away several fragments which endorse sensorial experiences.

B40 Much learning (*polumathiê*) does not teach intelligence: for, otherwise it would have taught it to Hesiod and Pythagoras, and again to Xenophanes and Hecataeus.

B35 Men who love wisdom must be investigators into very many things.

B55 All the things of which there is sight, hearing, knowledge (*mathêsis*) I honor most.¹⁶

¹² See 1010^a25–27: “those who took it to be so could fairly be criticized for asserting about the whole of the heaven what they saw only in a minority even of perceptibles.” (Trans. Reeve). See also 1063^b10–13.

¹³ See Anaxagoras B10 and B11 and Democritus A6 cited by Aristotle.

¹⁴ See Dilcher (1995) and Granger (2004). Begley (2020), p. 33 calls them the Incompatibilists.

¹⁵ I read *polymathy* as much instruction and not many experiences. The critique of Pythagoras for gathering doctrines of others to compose his own (B129) justifies this preference. Since Pythagoras practiced hearsay and not first-order experience, the reading accommodates the information in the set of fragments presented below. However, for the present investigation the acceptance of sensory information as a starting point is enough.

¹⁶ This is the second version of Laks and Most's translation. It is in line with most other translations and it is more neutral concerning the present discussion. Their preferred translation is: “All the things of which sight and hearing are knowledge I honor most.” *Mathêsis* (knowledge)

B101a: The eyes are more accurate witnesses than the ears.

B107 Bad witnesses for humans are the eyes and ears of those who possess barbarian souls.¹⁷

(trans. Laks and Most)

Even at a first glance, the fragments make it hard to defend a reason-only view. For instance, a necessary move for someone defending this reading is to dismiss B35 by claiming it to be ironical.¹⁸ Even if we accept such a questionable move, there are still the repeated appraisals of vision (B35, 55, 101a), the quintessential method for direct sensory contact.¹⁹ Thus, I believe it is safe enough to assume that Heraclitus operates on a framework of knowledge by contact in which sensory data still plays a crucial role.

On the other hand, the necessity of intelligence (B40), learning (B55), and a well-versed soul (B107) makes it clear that Heraclitus does not treat first-order visual contact as a direct window into reality.²⁰ Accordingly, he criticizes humans for failing to capture what they get in touch with (B1, B34, B56, and others). As expected from someone who thinks that nature loves to hide (B123), something more is required to achieve the proper interpretation of sensory information. Unsurprisingly, most scholars attribute a compatibilist view to Heraclitus in which knowledge acquisition accommodates sensory information and reasoning.²¹

Moreover, it is also necessary to look at what Heraclitus does and not only at what he says. After all, Aristotle proposes a reconstruction of what the Natural Philosophers do to reveal a mistake that escaped them. In several fragments,

may have both the empirical examination and an intellectual component. Kahn (1981), 35, for instance, reads it as learning from experience.

¹⁷ The barbarian souls would refer to souls that do not understand their own language. See Verdenius (1966), p. 98.

¹⁸ ‘Investigators’ in B35 translates *historas*. Marcovich (2001), p. 26 suggests that the word retains the tone of its original meaning of ‘eye-witness’. The reading is convincing since it matches the endorsement of vision in B5 and B101a. If so, the investigation should not be only internal and intellectual.

¹⁹ Vision is traditionally opposed to hearsay as a less trustworthy source of information for the historians. See Herodotus 1.183.3.

²⁰ Burnyeat (1979) identifies the model of perception as a window to reality operating in several ancient and modern philosophers.

²¹ There are different types and grades of compatibilism. For a lengthier discussion, see Leshner (1994) or Begley (2020). Both adopt different variations of a compatibilist view. I side with Barnes (1982), p. 115, also a compatibilist, in stressing the role of first-order contact in opposition to second-order. After all, in B26, Pythagoras is criticized because he formed his wisdom out of the writings of others.

Heraclitus points out sensory experiences that should help make the case for his worldview. This is the case of hot things getting cold (B126), young have turned into old (B88), day and night (B57), and satiety and hunger (B67). The attitude, once again, suits the unjustified generalization of sensory data. Thinking is not conflated with perceiving in Heraclitus, but it seems to be both based on and justifiable via information acquired through the senses. The second assumption delimits what type of information is in question.

2 Using change as sensory data (A2)

The second assumption of Aristotle's reconstruction specifies the type of sensory information used by Natural Philosophers in their generalisation. They see both contraries coming to be out of the same thing (A2).²² Aristotle uses the perception of change as an argument for the existence of change. Moreover, he seems to agree that changes occur between opposites.²³ These concessions explain why the difficulty of the Natural Philosophers is a legitimate one.²⁴ Nevertheless, their failure should also be easy to overcome.²⁵ Accordingly, while discussing the mistakes of the Natural Philosophers, Aristotle points out the conceptual shortcomings that mislead them to postulate a theory that accepts objective contradictions. They missed some metaphysical distinctions that, according to Aristotle, are necessary to give a proper account of change.²⁶

22 In A2 it is important to avoid assuming an Aristotelian conception in which the change between contraries occurs in a substratum. After all, this is the solution to the problem.

23 Aristotle usually distinguishes between contraries and contradictories (*Cat.* 11^b17–38). 'Contradictory' refers to exhaustive pairs of mutually exclusive affirmative and negative counterparts, such as white and not-white. Contraries are positive opposite items. They can be mediate contraries such as hot and cold allowing for an intermediate state like lukewarm. Contraries can also be logical immediate opposites such as odd and even in which there is no intermediate. These will not matter here since one does not see an odd number turning into even. Despite the differentiation, Aristotle, in 1009^a25 (see note 5), states that the Natural Philosophers assume the co-existence of both contraries and contradictories (*antiphaseis kai tanantia*). This is an indication that, for Aristotle, the Natural Philosophers did not make such a distinction. I use the term opposites when referring to this indistinct treatment.

24 See 1029^a23–24: "those who are genuinely puzzled" in Reeve's translation.

25 Their "ignorance is easily cured" in 1029^a18–20. The Natural Philosophers failed to distinguish contraries and contradictories, act and potency, quantity and quality, and substance and attributes.

26 In 1063^b10 Aristotle mentions that the things around the Natural Philosophers are evidently changing. He also claims that the basis for our judgments of truth should be the things that stay the same, like the heavenly bodies.

To put it schematically, for Aristotle substances can exist by themselves while qualities must exist on a substance.²⁷ Then, the change between opposites is constructed as the replacement of a quality for a different one on a substance.²⁸ Finally, for Aristotle, the occurring quality exists in act while the quality that will replace it already exists in potency.²⁹ Co-existence in act and potency does not characterize an objective contradiction.

Scholars agree that the opposites in the texts of the presocratics have an ontological status that cannot be captured by the Aristotelian distinction between substances and qualities, let alone act and potency. Unlike qualities, the opposites count as self-standing entities in the sense that they do not depend necessarily on a more fundamental entity to occur. Nevertheless, it is not the case that they occur alone in the world and should be treated as substances.³⁰ According to the standard presocratic view, an opposite rather occurs as part of some mixture or compound.³¹ Moreover, an opposite is defined by its relation of opposition with the other opposite. This relation is usually treated as a physical one; for instance, one opposite can change into another, suppress or prevail over the other. Thus treated, opposites include but are not restricted to Aristotelian pairs such as hot/cold and dry/humid. Opposites refer rather to a wide range of entities such as states of affairs, self-standing qualities, or, more simply, entities that can mix and/or transform into one another.³²

With this broader approach to the opposites in mind, it is time to check if references to occurrences of change between opposites figure in Heraclitus' world-

27 See 1069^b2–15. This is the so-called Aristotle's replacement model of change. See Gill (2004) for details. My focus here is on the presocratics, particularly Heraclitus.

28 Qualitative change should not be reduced to a quantitative one. In 1063a23–25 Aristotle says that even if we accept that everything is always changing in quantity, they still remain the same in respect to quality. See also 1063a26–28 “but the substance depends on quality, and this is of a definite nature, whereas quantity is of an indefinite one”.

29 It is far from clear how we should understand the physical processes underlying the replacement model.

30 Interpreters coined terms such as quality-things or character-powers to refer to the ontological status of entities such as hot and cold for the presocratics. See Cornford (1930), p. 84 and Mourelatos (2008), p. 306.

31 See Vlastos, (1950), p. 44. The characterization must be wide to encompass most of the presocratic doctrines. Some of them seem to be better read as mixtures that include opposites, others as compounds. The processes that explain the transformation from one to another vary accordingly. Some are conceived in a way that is closer to chemical transformations, others as mechanical or physical processes such as aggregation. See also the difference between Ionians and Pluralists in section 3 below.

32 Aristotle seems to follow the wide scope of opposites in the discussion. He even mentions the co-location of atoms and void in Democritus as a mixture of opposites (1009^a26).

view and if they play the relevant role described in both assumptions of Aristoteles' reconstruction. Namely, some exemplary cases of change between opposites should be captured by the senses (A2), and generalizations should also occur (A1). Here is a relevant set of fragments.

B126: Cold occurrences heat, hot occurrences cool, wet occurrences dry, dry occurrences moisten.³³

B88: The same within, living and dead, awake and sleeping, and young and old; for these, changing, are those, and those, changing, in turn, are these.³⁴

(my translations)

B67 God: day night, winter summer, war peace, satiety hunger. He changes just as <fire>, when it is mixed together with incense, is named according to the scent of each one.

B36 For souls it is death to become water, for water it is death to become earth; but out of earth, water comes to be, and out of water, soul.

(trans. Laks and Most)

In line with the unjustified generalization (A1), we see that what happens in ordinary examples, such as hot and cold, day and night, young and old, satiety and hunger, also applies to a more cosmological context involving the changing stuff in the cosmos. The variety of examples also fits an indistinct treatment of opposites by the presocratics.³⁵ There is a whole range of modes of existence and types of entities related in pairs, including states of affairs such as a young human becoming old, self-standing quality-things or stuff such as water becoming earth, or, more simply, general items such as night and day.

33 ψυχρὰ θέρεται θερμὰ ψύχεται, ὑγρὰ αὐαίνεται, καρφαλεὰ νοτίζεται. I follow the text as established by Dilcher (1994), pp. 276–77). The main difference is that in his edition there is more cohesion in the structure. For instance, all the subject are neutral plurals. However, for my point, even the most accepted editions in which most of the subjects are neutral plurals will suffice. I use 'occurrences' and not 'things' to convey the untranslatable idea of neutral plural to avoid the vocabulary of objects.

34 ταῦτό [τ' ἐν] ζῶν καὶ τεθνηκός καὶ <ταυ>[τὸ] ἐγγρηγορός καὶ [τὸ] καθεῦδον καὶ νέον καὶ γηραιόν· τάδε γὰρ μεταπεσόντα ἐκεῖνα ἐστὶ κάκεῖνα πάλιν μεταπεσόντα ταῦτα. Laks and Most (2016) think that the last sentence was an explanation by Ps. Plutarch. If so, it is a precise one. See B62 below.

35 Hot/cold and dry/wet, the paradigmatic opposites in Aristotle, appear in Heraclitus' B126. However, pairs such as day and night (B67) or water and earth (B36) also count as opposites due to the physical relation of one changing into the other. The same relation grounds the Heraclitean doctrine of the union of opposites.

Most of the fragments confirm the physicalist approach characteristic of the presocratics. In all cases except for B67, it is clear that what grounds the relation of opposition is the transformation between the relata.³⁶ In B88 the opposites are the same because they change into another. The dynamic physicalism is reinforced by the use of biological processes such as generation and death for the case of stuff in B36 (both fragments are discussed in section 5 below).³⁷

At this point, it is worth mentioning that there is a discussion if Heraclitus even conceived the notion of an opposite. There is no occurrence of *enantios* in the fragments.³⁸ And, from what we take from the fragments above, Heraclitus does not seem to be interested in a fixed status of being an opposite, conceived as one item A that has one and only one item B that is defined by its opposition to A. As a natural philosopher, Heraclitus gives more attention to the generative relation of opposition in which one item A arises out of its opposite B and vice-versa.³⁹ In this case, being an opposite is a relational matter. The relation occurs between two terms, but the set of relata can have more than two members. As B36 conveys, one item B can enter a relation of reciprocal generative opposition to an item A but also to another item C. Thus, when dealing solely with Heraclitus, maybe we should talk about opponents instead of opposites, emphasizing this relational approach to opposition. 'What is opposed' or 'opponent' (*antixoun*) appears in Heraclitus and is cited by Aristotle in B8 (also treated below).

At this point, it might be useful to compare the implied metaphysics of opposites in Aristotle and Heraclitus.⁴⁰ For Aristotle, contraries are the most different members that share a genus (1055^a26), a recipient (1055^a29), or a power (1055^a31).⁴¹

³⁶ Some readings try to see god as a unifying entity in which the pairs of opposites occur based on B67. After identifying god with fire, they suggest that the unifying factor is like an Aristotelian substratum. If this was the case, Heraclitus would have found the standard Aristotelian solution to the difficulty of elemental change. However, B36, the most representative fragment of elemental change in Heraclitus, gives no sign of a continuing underlying substratum in the change between opposites. Accordingly, Aristotle accepts that fire is the *archê* in Heraclitus, but does not see it as a substratum. Otherwise, he would not be able to find occurrences of contradiction arising from Heraclitus' worldview.

³⁷ The application of life and death to stuff is the rule and not an exception in Heraclitus' cosmological fragments.

³⁸ See Dilcher (1995), p. 109.

³⁹ Even if there is an incipient metaphysical or conceptual approach in Heraclitus treatment of the notion of opposition. See Mourelatos (2008), ch. 10 for such a reading.

⁴⁰ For the metaphysics of change between contraries in Aristotle, see Bogen (1992).

⁴¹ Aristotle also distinguishes between contraries and contradictories (see section 3). In the following, I use opposites when talking about the presocratics to mark their more vague use and focus on the physical items.

In the context of the phenomena in question, sharing a common fundamental factor – be it a genus, recipient, or power – grounds the fact that something turns into its contrary and not into another unrelated opposite.

Heraclitus' fragments provide no clear indication of a shared substance, substratum, genus, or the like underlying the changes between opposites. God in B67 might be an exception, but there is no indication of change in this case.⁴² B126 and B36 suggest that the process of change between opposites alone is enough to ground the order and reciprocity of their physical relation. The explanatory remark at the end of B88 confirms that change is what justifies taking the opposites to be the same. The absence of an underlying third term in the process of change is not surprising given the treatment of opposites in the presocratics seen in section 2. The opposites and their physical interaction suffice to ground the perceived aspects of their relation, such as polarity and reciprocity.

It is worth noticing that all these fragments serve as evidence for Heraclitus' so-called doctrine of the union of opposites. This union may be a source of contradictions in Heraclitus' worldview. Aristotle includes in the definition of contraries that they cannot be present at the same time (1018^a25), but there is no such an interdiction in the sparse treatment of Heraclitus. I will discuss some possibilities for understanding the Heraclitean union of opposites in section 4. For now, it suffices to acknowledge that (A2) in Aristotle's reconstruction applies to what we find in the fragments. As a matter of fact, (A2) is more easily applicable to Heraclitus than to Democritus, who is mentioned right after the reconstruction.

3 No generation out of nothing (A3)

The third assumption of Aristotle's reconstruction is the attribution of a shared assumption to the Natural Philosophers. They are not willing to accept generation out of non-being in their worldviews (A3). The oldest explicit formulation of such a prohibition in Greek philosophy occurs in Parmenides. It is usually accepted that Anaxagoras and Democritus, the two names that Aristotle uses to illustrate his reconstruction, follow several points of Parmenides' doctrine, including the problematization of generation out of non-being.⁴³

⁴² Some interpreters hold that god in B67 would play this role. However, in the presocratics, divinities seem to play a much more active role than a substratum. They provide an explanation for the order and continuity of change.

⁴³ For the influence of Parmenides over the Pluralists, see Curd (2004), p. 127.

Heraclitus probably did not have contact with Parmenides' doctrines. Nevertheless, this does not mean that he was willing to accept generation out of nothing. Aristotle attributed the willingness to avoid generation out of non-being to all presocratics, not only the post-Parmenideans.⁴⁴ Moreover, it is widely accepted that pre-Parmenidean presocratics consciously avoided it.⁴⁵ In fact, even the preceding sapiential tradition seems to do so.⁴⁶ However, an answer to the question whether A3 applies to Heraclitus is not so straightforward.

Generation out of non-being may have an absolute and a more restricted application. In the absolute version, something, a being, cannot be generated out of nothing, a non-being. On the other hand, a more restricted version claims that the property F cannot be generated out of $\neg F$. The restricted version fits the sensory data in A2, that is, opposites coming out of the same thing. Whether this counts as generation out of nothing will depend on further determinations.

The first point is that a distinction between contrary and contradictory may become significant. One of the contradictories is a negative entity, as for instance non-white in the contradictory pair white/non-white. Thus, a restricted version with contradictories could also violate the absolute version. White coming out of non-white could characterize a generation out of nothing. However, the view has advantages. It is easier to conceive the change from non-white to white without an interval in which opposites co-occur. Such an interval would characterize an objective contradiction. Contraries, on the other hand, are positive entities. In this case, the restricted version of generation out of a contrary property need not violate the absolute version. Health coming out of disease might be hard to understand and even imply in contradiction, but it does not come out of nothing.

Aristotle accepts change out of a contradictory, a negative item. To do so without assuming absolute generation out of non-being, he relies on the notion of a substratum and introduces the difference between act and potency. Thus, a subject will actualize a contradictory that it previously had only in potency. For instance, an uneducated person becomes educated. One of the reasons to think about change in this way is to avoid the contradiction that would arise from a change between two positive contraries. The proposal of a change out of a contradictory indicates that, for Aristotle, the principle of non-contradiction plays a

⁴⁴ See *Phys.* I.4 187a27–29; a34–35 and *Met.* 1062b24–25.

⁴⁵ Mourelatos (1981) offers a lengthier discussion.

⁴⁶ In poetry, an interdiction against generation out of nothing appears in Alcaeus Fr. 320 LP. Also, the role of Chaos in Hesiod is commonly seen as an attempt to avoid a beginning out of nothing.

more fundamental role than generation out of nothing.⁴⁷ The same is not the case with the presocratics.

As implied in the conclusion of Aristotle's general reconstruction, the Natural Philosophers may accept a physical contradiction to solve the problem of generation out of nothing.⁴⁸ If so, the interdiction of generation out of nothing is more fundamental than non-contradiction, which makes sense if there is no assumption that nature should follow the rules of reasoning or reasonable discourse. Moreover, as we saw, the distinction between a quality (F) and a substance does not fit the coarser view we find in the presocratics. This indicates that the problem of the Natural Philosophers is not with the restricted version, hot generating cold, but only with a restricted version that violates the absolute version, a negative state as not-hot generating hot.⁴⁹ The question that arises, then, is what sort of entity qualifies as a being in order to rule out generation out of nothing. Here, pre- and post-Parmenidean answers differ in a significant way.

Presocratic thinkers share a conception according to which the understanding of the world is grounded on its fundamental items. In his poem, Parmenides argues that if we accept generation of fundamental beings, they will have to come to be out of non-being, which violates the *ex nihilo* principle. Because of this problematization, in most post-Parmenidean cosmologies, fundamentalia are eternally enduring items in the sense that they can never cease to be nor lose their defining properties and powers.⁵⁰ Let me call a general version of such entity by a late nomenclature:

element, a fundamental entity (usually with a defining power) that cannot be generated, transform, or perish, but can move, be combined, and separated.

Elements, as defined above, are entities that satisfy most of the Parmenidean criteria for being. Because an element cannot come or cease to be, there is no generation or perishing.⁵¹ There is also no transformation since elements do not cease to be the way they are. Nevertheless, contra Parmenides, elements can be

⁴⁷ PNC is the most certain principle in 1005^b22–25. See also note 1.

⁴⁸ If we accept that the void in Democritus is a non-being, they would not even have a problem with the existence of non-being. The problem would be the strictly physical impossibility of generating something, like an atom, out of nothing, like the void.

⁴⁹ The Pluralists go as far as abandoning the notion of generation as a whole in order to avoid generation out of nothing.

⁵⁰ Parmenides B8.1–6 argues that to be a being an item should be ungenerable, unperishable, whole, unshaking, and complete.

⁵¹ The Pluralists go as far as abandoning the notion of generation as a whole rather than having to accept generation out of nothing.

a plurality, move, and form composites.⁵² This allows the Pluralists to postulate a plurality of elements to play the role of the building blocks of the world. Anaxagoras claims that what we see as generation is a separation of ingredients out of an original mixture. In Democritus, the sensible things are aggregations of imperishable atoms.⁵³ In sum, the Pluralists solve Parmenides' problematization of generation and destruction by reducing them to movement and re-combinations of fundamentalia.

Before Parmenides, on the other hand, there were no such strict criteria of existence for (fundamental) beings. The Milesians inaugurated the reliance on material *explanantia* to account for both the origin and the maintenance of the cosmos.⁵⁴ To do so, they postulated fundamental items that were original, eternal, and yet able to go through transformations. Again, to use a label that is probably of later use:

archê, material stuff that is fundamental in the sense of lying at the origin and guiding the changes in the world.⁵⁵

An *archê* may play its fundamental and regulative role by transforming itself. Then, the question is how an item can be eternal and yet self-transforming. This is not the place to answer such a tricky question. I just want to suggest that the view is not as ingenuous as it may sound. A plausible way to frame this type of worldview comes from the realization that these entities behave more like stuff than objects. Stuff is a pre-individuative notion usually defined as cumulative, dissective, and formless.⁵⁶ Due to cumulation, if one adds more water to water, one still has water. Due to dissection, if one serves portions of a soup into different bowls, one still has the same soup even if non-contiguously distributed. Finally, a statue of copper and a lump of copper are easily identifiable as the same copper, which has no form. These features show that the identity conditions of stuff are much more permissive than in objects. It would sound outrageous to claim that an object can increase, be divided, or change its form without

⁵² Some readings of Parmenides admit other kinds of monism that may have pluralities, but this is not the point here.

⁵³ See Anaxagoras B17 and Democritus B167.

⁵⁴ See Graham (2006), p. 10.

⁵⁵ The definitions of element and *archê* are vague in order to encompass a variety of positions. What matters the most is the central contrast between permanence and transformation. To see how the distinction is artificial, one can notice that Anaxagoras' mixtures are matter-like and not atomistic as in Democritus. However, as elements, they do not suffer transformations. All there is re-arrangements in the parts of the mix.

⁵⁶ Pelletier (1979), p. vii offers a presentation of these properties.

losing its identity. Yet, we accept it when we talk about stuff in ordinary language. Thus, a pre-individuative approach may offer an alternative to thinking about the treatment of the *archai* by the Milesians. In particular, because these aspects may also apply in relation to time.⁵⁷ Many process philosophers claim that processes are the equivalents of stuff among items with temporal extension. The disjunctive feature matters the most here. One can talk of the same stuff-like dynamic entity persisting through a non-contiguous period of time. The same tempest can occur throughout non-contiguous regions and time intervals without ceasing to be the same. This approach to stuff and processes appears in ordinary language and, as such, does not presuppose awareness of the complex metaphysics underlying it. As such, they offer a plausible framework to acknowledge how an item can go through partial and temporal transformations and yet be seen as eternal, as the Milesians seem to have treated their *archai*. A stuff-like fundamental matter may serve as an origin, thereby avoiding generation out of nothing, without requiring that there is no change, transformation, or generation.

With these two paradigms of fundamental entities at hand, namely, element and *archê*, it is time to examine how the unwillingness to accept generation out of nothing leads the Natural Philosophers to the denial of PNC according to Aristotle's reconstruction.

4 Objective contradiction (C)

Now we can take a more informed look at all the steps of Aristotle's reconstruction. The Natural Philosophers build their worldview by generalizing information gathered through the senses (A1). To generalize, they took the change between opposites as the main type of sensory information without making many metaphysical distinctions (A2). Furthermore, they are not willing to accept generation out of what is not (A3). Hence, the problematic conclusion. The Natural Philosophers suppose that an opposite which becomes manifest already existed before. Since they do not recognize different ways of being, the situation characterizes a state of objective contradiction. The opposites co-exist in the same way, in the same thing (C).

The qualification 'in the same way' is of particular importance. After all, part of Aristotle's solution to this legitimate *aporia* consists in differentiating ways of

⁵⁷ See, for instance, the treatment of 'dynamic masses' and 'free processes' in Seibt (2004), who recognizes Sellars and Broad as predecessors of this view.

being.⁵⁸ If the opposites pre-exist, but one exists in act and the other in potency, there is no violation of PNC.⁵⁹ Given the importance of the modes of being, the difference between element-like and archê-like entities proves to be significant.

In a version of the reconstruction restricted to the pluralists, *homoiôs* in (C) would mean ‘like an element’.⁶⁰ Elements, as conceived by the Pluralists, cannot be generated since they follow Parmenides’ criteria for being. And the Pluralists did treat many opposites as element-like entities. For instance, hot and cold are included in the theory of everything is in everything in Anaxagoras.⁶¹ If certain opposites will satisfy the Parmenidean criteria of being, they cannot be generated. It follows the common pluralist strategy of presupposing that the opposite in question already existed before it became manifest. This Pluralistic version of the reconstruction fits the conclusion proposed by Aristotle. The opposites pre-exist in the same way (*homoiôs*), in the same thing, characterizing an objective contradiction. However, this is not the case with *archai*.

We saw in (A3) that pre-Parmenidean presocratics accept the transformation of fundamentalia. The transformation might offer a way out of the contradiction because, in this case, the opposites do not need to pre-occur. One can simply generate the other. With this in mind, it is time to investigate whether the Heraclitean union of opposites meets the conditions for an objective contradiction as described in the conclusion (C).

58 See *Physics* I.2 (at 186^a22–25), where Aristotle says of Parmenides that ‘his false assumption is that things are said to be in only one way when, in fact, they are said to be in many.’

59 1009a32 reads: ‘It is possible for contraries to potentially belong to the same thing at the same time, but not to do so actually.’ (trans. Reeve). See Sattler (2020), p. 34 for the development of PNC in light of this and related passages. She shows that the qualification that a violation of PNC requires that the contraries must be *in the same respect* appears earlier but it is not clearly presented before Plato and Aristotle.

60 The argument is general and the nuances of the pluralist positions will not be addressed. To explain how one thing becomes its contrary, a Pluralist might claim that the contraries are not beings in the strict sense. Democritus, for instance, says that hot and cold exist only by convention in B9. For Aristotle, however, the fact that atoms occupy the void characterizes a situation in which being and non-being occur together (*hama*) existing in the same way (*homoiôs*).

61 There are many interpreters who deny that the opposites in Anaxagoras are particulate, that is, atom-like entities. See Barnes (1979) and Schofield (1980). Curd (2017), p. 181 proposes that they are treated as a liquid or a paste. These states suggest that they are mixed rather than added to each other. Independently of their state, they cannot turn into another. This is what the general definition of element above requires. There is no presupposition that they are atom-like particulate.

Relying on fragments like B88 (cited in section 2), in which opposites such as life and death are said to be the same, Barnes (1979), p. 54 attributes to Heraclitus the fallacy of dropping the temporal qualifications.⁶² He claims that out of the fact that any mortal item that is living at time t will die at some time $> t$, and that every dead mortal item at t was living at some time $< t$, Heraclitus concluded that living and death are one and the same without qualification.⁶³ In this reading, a contradiction would clearly apply to Heraclitus. However, independently of a fallacious move, dropping the temporal qualifications leads to a very un-Heraclitean scenario. Thinking in physical terms, once the opposites are identified, change becomes impossible. Aristotle spots such unintended non-mobilism as an implication of a doctrine in which contradictories are true of something at the same time (1063a17–21) and in which everything is on everything (1010a34–37). After all, in both scenarios, there will be no different state to move from or to.⁶⁴

The ‘everything on everything’ immediately brings Anaxagoras into mind.⁶⁵ The unintended non-mobilism seems to follow from a situation in which there was a pluralist-like interdiction of transformation and generation of fundamentalia. However, we saw that this does not apply to pre-Parmenideans. Given the historical context, Heraclitus’ worldview should be closer to that of the Milesians. This expectation is confirmed textually by the transformations between cosmic stuff and the biological vocabulary of life and death in B36. More importantly, Heraclitus puts even more emphasis than his predecessors on the processual aspect of the world. As we saw in section 2, the fact that one opposite turns into the other seems to be the physical fact grounding Heraclitus’ claim that they are somehow the same. If so, the union of opposites cannot rely on an identity claim that hinders transformation.

There are many readings proposing process-friendly views of the Heraclitean union of opposites. Graham provides a convincing and well-developed version.⁶⁶

⁶² See also Emily-Jones (1976) and Stokes (1971).

⁶³ In *Soph. El.* 166b37 Aristotle remarks that it was common for thinkers to go from ‘ x being F at t_1 ’ to ‘ x is F simpliciter’.

⁶⁴ Wedin (2004), p. 236 thinks that, for Aristotle, this is a consequence of Heraclitus’ position as well. I believe that it is a reference to Anaxagoras and other post-Parmenidean positions. This would not apply to the Milesians, in which there is transformation of matter. See the following note for my reading.

⁶⁵ I believe that in (1010a34–37) Aristotle is thinking of Anaxagoras and other doctrines that presuppose that opposites pre-co-exist. Right after this passage he starts another paragraph with an ‘and if’, indicating that this is another point. He then envisages the case of things that are always flowing in a quantitative aspect. I believe this is the view he attributes to Heraclitus.

⁶⁶ The most developed of these readings see Graham (2006), p. 123.

According to what he calls Transformative Equivalence, the fact that A turns into B and B turns into A suffices for Heraclitus to say that they are one and the same in the sense of being part of a structured process of change. We can put this interpretation in terms of the assumptions of Aristotle's reconstruction. Heraclitus observes the repeating structure of reciprocal change between opposites. Such a structural unity confirms that the opposites are parts of the same process. The view is then generalized as a recurring feature of the cosmos.⁶⁷

The reciprocity of the change between opposites in Heraclitus also allows him to avoid generation out of nothing. After all, one opposite is the source of the other and vice-versa. Moreover, since transformation between the opposites and extension in time occurs, he also seems to avoid the accusation of postulating a state of objective contradiction. The avoidance occurs on two levels.

First, beginning and end are the same in a reciprocal process; however, what we have is the beginning of A being the end of B. Once we have different aspects, they do not co-occur in the same way (*homoiôs*). Secondly, the process of A turning into B is extended in time; thus, the extreme opposites do not occur together at the same time (*hama*). If so, despite fitting very well in assumption 1 to 3 of Aristotle's reconstruction, Heraclitus' processual view would escape the problematic conclusion as formulated in the conclusion (C).

Such a reading may justify why most scholars are not willing to include Heraclitus among those contemplated in Aristotle's general reconstruction of the Natural Philosophers' reasoning. And, since Heraclitus was not a sophist, the conclusion is that Aristotle's depiction of Heraclitus as a typical PNC denier in *Metaphysics* Γ misses the point.⁶⁸ However, this conclusion may be too hasty.

We have seen that Aristotle's reconstruction of the reasoning that led the Natural Philosophers to endorse objective contradictions is a general one. As such, we cannot expect that it deals with the details of different positions. Moreover, within this reconstruction, the hypothesis that the conclusion arises from the observation of change between opposites seems to apply more clearly to Heraclitus than to any other of the mentioned presocratics. Nevertheless, the internal problem for the inclusion of Heraclitus in Aristotle's reconstruction is that a

⁶⁷ Aristotle sometimes attributes a strong mobilism to all the earliest natural philosophers, including Heraclitus, while also defending that one fundamental thing persists. See *De Caelo* III.1 298^b14–33. As indicated above, treating the *archai* as matter-like might be more plausible.

⁶⁸ For readings of Heraclitus in which there is no denial of PNC, see Graham (2006), p. 119, Rapp (2007), p. 77, and Dilcher (1995), p. 105. However, none of these interpretations consider the occurrence of objective contradictions during the process of change between opposites. For me, this is the most plausible and charitable reading. Change is, after all, still a subject of philosophical debate as a state in which there may be true contradictions.

dynamic worldview seems to avoid the charge of endorsing objective contradictions.

One of the reasons for this problem is that the objective contradiction in the conclusion of Aristotle's reconstruction tends to be read exclusively in a static way, as the static co-location of opposites. Such a scenario would apply to the Pluralists, in which there is no generation or corruption of fundamentalia, but not to the Ionians for whom the *archai* can suffer transformations. However, there seems to be no reason to restrain the conclusion to such a static reading. There are scenarios in which objective contradictions can occur within a dynamic setup. Moreover, as we are about to see, Aristotle presents some of these scenarios in his discussion of change of change in *Metaphysics K* and *Physics V*. These discussions allude to the reconstruction of the Natural Philosophers' reasoning in *Metaphysics Γ*.

In the following section, I will explore if these scenarios of contradiction in a dynamic setup fit Aristotle's presentation of Heraclitus' worldview. While doing so, I will examine Heraclitus' preference for a paradoxical mode of expression to verify to what extent Aristotle's description fits what we find in the fragments.

5 Contradiction in processes

Metaphysics K repeats several themes that appeared in the argument against the Natural Philosophers in *Metaphysics Γ*. In K 6, like in the ex-nihilo assumption (A3), Aristotle once again states the opinion shared by natural philosophers according to which nothing can come out of what is not (1063a23). A couple of paragraphs below, he warns against taking the sensory evidence that things in the sublunary world are changing to ground judgments about the truth. The warning is a more determinate description of the unjustified generalization seen in assumptions (A1) and (A2) above. After that, Aristotle states that contradictories cannot be true, at the same time, "as our opponents claim they are" (1063^a21). The formulation echoes the conclusion (C) of the reconstructed argument in *Metaphysics Γ*, with the addition that, this time, the discussion focuses on the changing things.

After some paragraphs, Aristotle confirms that the Natural Philosophers are still among the envisaged opponents. He says that neither Anaxagoras nor Heraclitus can be speaking the truth, for, if they were, contraries would be predicable of the same thing. Given the previous distinction between Ionians, who accept transforming *archai*, and Pluralists, who do not, the question of the extent to which these two worldviews should be treated together arises for Aristotle. In

the discussion in *Metaphysics* Γ, Anaxagoras is criticized because his worldview would prevent the occurrence of change (see note 65 above). If everything already has everything, not only opposites will be co-located, but no change will be possible since the supposedly forthcoming opposite is already there. However, he does not seem to attribute such a non-mobilism to Heraclitus.

Aristotle always presents Heraclitus as a radical mobilist according to which every sensible thing is always changing.⁶⁹ Luckily, more direct evidence is available concerning which were the central features of Heraclitus' worldview according to Aristotle. Heraclitus' B8, cited in *Nichomachean Ethics* VIII.1 1155^b4, gathers what Aristotle took as a representative description of the transformation between opposites in Heraclitus:

B8 What is opposed (*antixoun*) converges, the most beautiful connection comes out of (*ek*) what is diverging, and all things are generated by strife. (*my translation*)⁷⁰.

The fragment seems less like a verbatim quotation and more like a compendium of Heraclitus' views on process and generation. Since the words and themes reoccur in other fragments, the consensus is that B8 constitutes a faithful collection.⁷¹ In general, opposition generates a connection, and strife epitomizes generation through opposition. However, the most relevant aspect here will be the generative connection between convergence and divergence as opposite processes. After all, the discussion in *Metaphysics* K explores the problems of putting a process at the origin of another process.

Diverging or differentiation (*diapheron*) is, of course, a term for a process of change. The word reoccurs in B51 and is likely to be Heraclitean.⁷² In B8 the par-

⁶⁹ See, for instance, "[for Heraclitus] all sensible things are always in a state of flux" (*Met.* 1078^b14). Since Reinhardt (1916), many scholars think this sort of radical mobilism comes from Plato's attribution of a flux theory to Heraclitus. Virtually everyone accepts a mild mobilism in agreeing that change is a central aspect of nature for Heraclitus. Some defend a restricted mobilism according to which, in everything, there is always some aspect that is changing.

⁷⁰ τὸ ἀντίξουν συμφέρον καὶ ἐκ τῶν διαφερόντων καλλίστην ἁρμονίαν καὶ πάντα κατ' ἔριν γίνεσθαι. I use 'connection' instead of 'harmony' following Diels' widely accepted remark that the sense is more physical than musical.

⁷¹ The word for what is opposed (*antixoun*) is archaic, which supports the fidelity of the source used for the citation. See Robinson (1991), p. 81.

⁷² The manuscript reads *homologeō* (agree). Most editors substitute it with *diapherō* based on Plato's *Symposium* 187A that repeats the symmetric *sympherō*/*diapherō*. The opposition is stronger in the symmetric version, but the asymmetric construction suffices for the purposes of the present discussion.

ticiples is paired with its etymological opposite, convergence, giving a contradictory tone to the statement. The use of the participle in both cases emphasizes the processual aspect. Moreover, the convergent is coming out of ‘what is diverging’. The generative relation between the opposite terms is described through *ek* + genitive, the same construction used by Aristotle to convey ‘the change of change’ in *Metaphysics* K (*Met.* 1068a34).⁷³

In light of B8 and the general treatment throughout the *corpus*, it seems safe to assume that Aristotle attributed to Heraclitus a worldview in which a process of change lies at the origin of another process of change. If so, the non-mobilist contradiction through the co-location of opposites that Aristotle attributes to Anaxagoras should not apply to Heraclitus. Nevertheless, Heraclitus’ worldview should also lead to the occurrence of objective contradictions. After all, this is what justifies the treatment of both natural philosophers in the same passage above. To address Heraclitus, Aristotle would have to conceive of a dynamic situation in which the change between opposites, falsely constructed, entails a contradictory state. Such a conception appears in the critique against change of change in *Metaphysics* K.12 and *Physics* V. As we are about to see, many aspects of the critique fit the radical mobilist worldview that Aristotle attributes to Heraclitus based on the features compiled in B8.

Alteration

The critique against the change of change in K.12 reoccurs in *Physics* V.2. I rely on the text of the latter because it is more accepted. Aristotle examines the consequences of accepting movement of movement in alteration and becoming of becoming in generation. I will treat each of them in turns.

In the relevant case of alteration, Aristotle describes a situation in which a subject would change from one changing state to another, for instance, a human being changing from sickness to health (225^b20). The situation is described as changing at the same time (225^b27) to something else that is the opposite change, for instance, becoming healthy (229–30). To put it more succinctly, there is chang-

⁷³ Plato’s *Symposium* 187A repeats the same structure (*ex* + genitive) and words (diverging/convergence) to convey the ‘absurdity’ of a generation out of a differentiation. Pradeau (2002) thinks that this is a direct quotation. However, most editors think that Hyppolitus’ version in B51 is more faithful. This version has a dative to reinforce the convergence ‘with itself’. The dative seems even more suggestive of a mixing of opposite processes that would lead to an objective contradiction, as will be argued in the following.

ing from becoming sick to becoming healthy. Thus stated, the human (their body or soul) does not play the role of a substance or substratum in the process. This absence is necessary. After all, this is the scenario that Aristotle wants to refute. The assumption of an underlying continuant is part of his solution.

Aristotle answers someone who would use this apparent counter-evidence by pointing out that the described scenario is only coincidentally true (225^b30–31). First of all, the changes culminate in a state of rest (225^b28) and not a process, that is, being sick instead of becoming sick. Moreover, as an alteration, these changes occur in a substratum that continues throughout the change. What happens is that the substratum to which the opposite states belong changes to one state, and then to another (225^b31–32). Despite the appearances, there is no becoming sick changing into becoming healthy but rather a human being that ceases to be sick and comes to be healthy.

In his answer, Aristotle is relying on his replacement model of alteration to explain away the counter-evidence, just like in the discussion in *Metaphysics Γ*. Once we assume the replacement model, those who posit the change of change miss two points.

Being: the end of a change is a state and not another change.

Continuant: the different states occur in the same subject.

The difference between being and becoming will be central in the discussion of generation below. For now, let me focus on the role of the continuant. We have just seen that Heraclitus' worldview seems to presuppose the change of change based in B8, cited by Aristotle. Moreover, there is no allusion to a continuant in the connection coming out of the divergent. However, the fragment focuses on generation. B88 (cited in section 2 above) provides a better case study to explore alteration-like change in Heraclitus.

The fragment presents another instance of the union of opposites by saying that young and old, awake and asleep, living and death are the same within. For now, it is not relevant if these are states or processes. The central issue is that they all occur in human beings. If so, according to Aristotle's model, the human plays the role of a continuant. However, Aristotle's answer to his opponents implies that they would neglect this factor. B88 does not contradict this view. After all, what Heraclitus offers as a justification for the sameness of the opposites is the observable fact that one is changing into another and presumably vice versa.⁷⁴

⁷⁴ With the exception of waking and sleeping, the other pairs do not sound as good examples for reciprocal changes nowadays. Old turning young could derive from the habit of naming

The participial form of the verbs for change (*metapiptô*) reinforces the processual aspect. There is no reference to a continuant. The change is grounding the continuity between the opposites.⁷⁵

The fact that the continuity is based on the changing suffices to characterize Heraclitus' as a process approach. As such, it should be contrasted with the replacement model in which the continuity based on the substratum is justified *despite* the change. If there is a change from one opposite to another without the supposition of a continuant, the situation, for Aristotle, would resemble more a generation than an alteration. Unsurprisingly, the sequence of the critique against change of change in *Metaphysics* K and *Physics* V encompasses the case of generation of generation.

Generation

The consideration of change of change in the case of generation starts with an argument focusing on becoming followed by one focusing on perishing. The focus on becoming leads to a regress (225^b34).⁷⁶ After this argument, Aristotle explores another problem with generation of generation focused on the role of perishing. I want to argue that, in this case, Aristotle provides a scenario in which an objective contradiction arises in a dynamic state. After examining the argument, we shall see if the state applies to Heraclitus. The lines of interest in *Met.* 1068^b6–9/*Phys.* 226^a6–10 read:

Further, the same thing that admits of movement also admits of the contrary of movement (and furthermore of coming to rest), and of coming to be and passing away. *So what is coming to be [coming to be] is passing away when it has come to be coming to be.*⁷⁷ For it

grandsons after grandfathers (Marcovich 2001, p. 218). For living and dying, the most important case in this discussion, B62 will help.

75 Aristotle uses *alloioô* and *metapiptô* to refer to non-generative change. But verbs occur in Heraclitus, B67 and B88, respectively. Thus, it could imply a mechanical quantitative change without transformation in B88 (i. e. condensation/rarefaction). However, as discussed below, Heidel (2014) pointed out that the presocratics use *alloioô* and others also in the context of change by mixture (*mixis/kraasis*).

76 Duncombe (2022), in this special number, offers a careful analysis of the argument.

77 ἔτι τοῦ αὐτοῦ κίνησις ἢ ἐναντία καὶ ἡρέμῃσις, καὶ γένεσις καὶ φθορά, ὥστε τὸ γιγνόμενον, ὅταν γένηται γιγνόμενον, τότε φθείρεται: οὔτε γὰρ εὐθὺς γιγνόμενον οὐθ' ὕστερον: εἶναι γὰρ δεῖ [10] τὸ φθειρόμενον. In his translation, Reeve seems to be following Ross (1934), p. 623, who, based on the manuscript E¹, introduces a *gignomenon* after the ὥστε τὸ γιγνόμενον (which is absent from all other manuscripts). Tredennick (1934) translates the text established without

cannot pass away (i) as soon as it is coming to be, nor (ii) after it has come to be, since (x) what is passing away must be. (my brackets and italics, trans. Reeve)

The passage starts with (*eti*), indicating that Aristotle is not re-stating the same point of the preceding argument of regress. It is common to read the quoted argument as a *reductio*. It starts with the assumption that if there is becoming of becoming, there must be perishing of becoming. If so, the conclusion in italics follows, namely, what is becoming is also perishing, which is absurd.⁷⁸ The state of a perishing becoming characterizes an objective contradiction in a dynamic setup. As such, it fits the general conclusion (C) of the argument against all the Natural Philosophers seen in section 4 above. In order to better understand such a contradictory state, we must dwell on the argument.

The occurrence of the problematic scenario – a becoming that is perishing – is justified through the denial of alternatives (i) and (ii). They are denied because they fail to satisfy the unavoidable condition presented at the end of the argument. According to (x), what perishes must exist, that is to say, the perishing must be of something. This something may refer to a ‘being’, a complete existence, or existence in a looser sense. For Aristotle, strictly speaking, the perishing should be of a being. However, since Aristotle is talking about the problems concerning becoming of becoming, it is necessary to accept a loose sense in which becoming satisfies existence. Thus, in the following, I take (x) to mean that perishing must be of something that exists but does not need to be a being.

According to (i), the perishing occurs as soon as becoming starts. As the argument is constructed, if we accept (i), the perishing will have nothing to be the perishing of. The indication of immediacy by ‘as soon as’ (*euthus*) should also be significant. Taking into account the immediacy and the non-existence of an object for the perishing, I believe that the scenario in (i) presents a sudden destruction occurring right after the becoming begins.⁷⁹ After the early destruc-

the addition: “Therefore that which comes to be, when it has come to be coming to be, is then in course of perishing.” I believe that the addition is not necessary and even adds confusion. The central point seems to be that what became a becoming (i. e. what is becoming) is perishing while becoming.

78 Tredennick (1934) puts in a note “sc. which is absurd”. See also Ross in the following note.

79 Ross (1936), p. 624 thinks we should suppose a becoming ‘of a becoming’ in (i). Thus, the perishing occurs when the becoming of the becoming starts, namely, before the relevant becoming started. Ross’ interpretation is sufficient for my point. It concludes that if perishing cannot occur before or after the becoming, the perishing will occur together with the becoming. In his words: “it ceases to be while it is coming to be, which is absurd”. However, the introduction of the becoming (of a becoming) renders the *euthus* unnecessary. By following the text without

tion takes place, there will be nothing available to be the object of perishing. In this way, the scenario fails to satisfy what (x) requires.

According to (ii), perishing cannot occur after. The ‘after’ can refer to after the becoming started but also to after the becoming came to be, namely, after it was accomplished. Since (i) already concerns destruction after the start of the becoming, I believe that it is better to read (ii) as after the becoming *came to be*. I take this option to mean that the perishing of a becoming cannot be the destruction of a being. After all, when there is being, becoming already ceased, and, as stated in the last line of the argument, for something to perish, it must exist.

At this point, it might be worth stating the unproblematic version of the perishing of a being to serve as a comparison. Becoming, for Aristotle, is a process defined by its end product, which is a being. This product comes to be after the becoming is over. Conversely, perishing is the destruction of being. As such, it occurs only after being has been produced, and thus also after the becoming has already taken place. If there is a being before and after the becoming, no contradiction will follow, even if the perishing is extended.⁸⁰ In A turns into B, there is the becoming of B and the passing away of A. They might even be simultaneous, but the co-occurrence of opposite processes in relation to different aspects is not a contradiction. On the other hand, at least, as Aristotle’s argument goes, if one admits the becoming of a becoming, one must also admit the perishing of this becoming, which is not of a being. This will lead to problems.

The problematic conclusion that accomplishes the *reductio* cannot be excluded by the same reason of (i) and (ii). Thus, in its case, what is perishing must somehow exist. The perishing cannot suddenly occur after the becoming started, as in (i). Neither can the perishing occur after the becoming was accomplished, as in (ii). Thus, the perishing – to be the perishing of this becoming – must occur throughout the becoming. This implies the absurd scenario of the conclusion in which becoming and the perishing of this same becoming occur together. Thus, the conclusion of the *reductio* instantiates a contradictory state

further assumptions, the proposed reading adds a dimension to the argument. The perishing of a becoming cannot occur as soon as the becoming started. Since a becoming to be a becoming must be extended, its perishing will also have to be extended. The absurd state is then one of a becoming that is perishing. This is also indicated by the ‘while (*tote*) it ceases to be’.

80 If there is a substratum, there will be no problem as well. The substratum can be gaining G while losing F. In *Physics* V.5 229^b10, Aristotle says that generation to one thing and passing away from one thing are contrary changes. See also *On Generation and Corruption* I.3 318^a23–35, in which generation of a substance is conceived as the destruction of another substance. According to the standard reading, this change for Aristotle would occur on an imperceptible substratum.

that is dynamic and fits the general conclusion (C) of the argument against the Natural Philosophers in *Metaphysics Γ*.

The absurd situation of a perishing becoming is not far from the ‘diverging convergence’ in a context of generation mentioned in B8. However, if we want to examine Heraclitus’ worldview, B62 provides stronger evidence for a co-occurrence of becoming and perishing conceived as a contradictory state.

B62 Mortals immortals, immortals mortals, living the death of these, dying the life of those.⁸¹ (*trans. Laks and Most*)

The fragment opens with a paradoxical chiasmus suggesting a case of a reciprocal union of opposites like in B36. The terms, however, are mortals immortals.⁸² The following explanatory sentence repeats the structure we saw in B88 in which the processes of transformation are given as evidence of the union of the relata. Additionally, B62 presents the processes of living and dying as the unification factor. They are closer to the biological vocabulary of generation and death in B36. Despite the common structure, the fragment is stylistically the most pungent of the group. The way in which participle and object are presented in ‘living the death’ and ‘dying the life’ would certainly catch the attention of the trained ears of Heraclitus’ audience. To understand its effect, it is necessary to compare it with the common use of the so-called cognate or internal accusative in ancient Greek.

The cognate or internal accusative consists of using a pleonastic direct object that repeats and thus reinforces the expressed meaning of a verb. This was a common rhetorical device.⁸³ If presented in the traditional way, a Greek audience would expect something along the lines of ‘living the life’ in B62. In opposition to that – and to reveal the union of opposites – Heraclitus twists this rhetorical figure and creates an *anti-cognate* accusative as in ‘living the death’. Moreover, he presents its mirrored version ‘dying the life’ right in the sequence generating a chiasmic structure. If the fragment was describing a reciprocal sequence of pro-

⁸¹ ἄθάνατοι θνητοὶ θνητοὶ ἄθάνατοι ζῶντες τὸν ἐκείνων θάνατον τὸν δὲ ἐκείνων βίον τεθνεῶτες.

⁸² There is much discussion about what ‘mortal and immortal’ refers to. It is not unusual to read it in connection to B36. Based on the unexpected variation between singular and plural for souls/soul in B36, Betegh (2007) suggested that the fragment talks about the cycle of *psuchê* as a cosmic stuff being individuated as a soul. If so, in B62 mortals could also refer to individuated cosmic stuff in humans and immortals, to the cosmic stuff. Their coming and ceasing to be reveals another instance of the union of opposites. But here I will focus on the description of the process.

⁸³ Norwood (1952) gives examples such as ‘battling the battle’ (*Il.* XV.414), ‘act the act’ (Aristoph. *Wasps* 375–76), and ‘envoy the envoyes’ (Thuc. VI 56).

cesses, we should expect something like ‘A living the death of B’ and ‘B living the death of A’, just like in B36. Instead, B62 presents mirrored anti-cognates. Thus, the internal relation of A living the death of B and B dying the life of A is highly suggestive of a co-occurrence. Even more than before, the paradoxical language suggests an awareness of a contradictory state.

The reading also makes sense historically. As Heidel (2014) argues, change in most presocratics seems to be seen as a result of the mixture and interaction of constituents rather than a mechanistic process. In his words, it is closer to chemistry than to physics. The vocabulary also confirms that it is even closer to biological transformation, which also implies the interaction of the constituents.⁸⁴ Additionally, living the death and dying the life is not far from a coming to be while perishing, the contradictory dynamic state described in Aristotle’s *reductio* in 226^a.

Heraclitean change

If the investigation in the previous section makes sense, according to Aristotle, Heraclitus conceived changing as the transformation from one process to its opposite. Since he did not presuppose a continuant underlying the process nor differentiate between the process of becoming and the state of being, his worldview entails the co-occurrence of opposite processes. B88 seems to confirm the dismissal of a continuant. B62 suggests the co-occurrence of opposite processes and awareness of an objective contradiction. Now I want to argue that this is a better interpretation of Heraclitus’ description of elemental transformation in B36 than the alternatives that avoid the occurrence of objective contradictions.

We have seen in section 4 that, in some interpretations, a process-friendly reading of Heraclitus should suffice to avoid the accusation that his worldview entails a contradiction. B36 (quoted in section 2) offers the main evidence. The text states that the generation of A is the death of B and vice versa. There is no indication of a continuant underlying the process. The talk about becoming confirms that there is a reciprocal transformation between them. Because there is the generation of B and the death of A, the opposites would not occur simultaneously or concern the same aspect. Hence, no contradictory state needs to be presup-

⁸⁴ See also Plato (*Tht.* 157A), in which Heraclitean change is described as an ‘intercourse’ (*homilia*) between active and passive elements. *Alloioō* appears as equivalent to *apollumi* (destruction/death).

posed. However, a couple of assumptions are required for such a scenario in B36 to avoid the occurrence of objective contradictions.

Since the generation of B is the death of A, the processes need to be simultaneous and have the same extension. If so, the only alternative to avoid contradiction is to assume that these are sudden changes. The transformative processes will have no extension. Furthermore, in order to avoid co-occurrence, the opposite states must not share a limit. The scenario that follows is something like this: There is a period in which A obtains; the sudden generation of B and sudden death of A (conceived as different changes); and a period in which B obtains. In this type of interpretation, the change between opposites in Heraclitus ends up being described as a discontinuous succession of opposites. A does not turn into B. B only follows A.⁸⁵ The worldview ends up implying a static theory of change in which there is A and then, on the following instant, there is B and vice versa.

The discrete reading does not fit Aristotle's view of the Natural Philosophers. After all, in such a reading, the material causal chain between the opposites loses its ground. A could simply vanish into nothing, and B could simply arise out of nothing. This would violate the *ex nihilo* principle (A3). Moreover, the reading would also allow anything to come to be after anything. This permissiveness goes against the sensory data according to which one opposite comes after the other (see A1 and A2 above). Finally, in the case of mobilist positions (including those who accept the transformation of the *archai*), the perishing of a becoming characterizes a dynamic state of objective contradiction.

Concerning Heraclitus, the text of the fragments endorses Aristotle's general interpretation. Several fragments present a chiasmic structure ABBA that endorses a fixed structure of reciprocal change between opposites (B36, B88, B62). B36 says that the generation of A is the death of B, suggesting that the death of one opposite is conceived as the material origin of the other.⁸⁶ As seen in B88, it is the changing between opposites and not a continuant underlying the process that grounds the union of opposites. Moreover, if the opposite that is coming to be comes out of the opposite that is ceasing to be, the material connection in a continuous process will characterize a state of objective contradiction. Such a

⁸⁵ In such a scenario, A is not a becoming. B is not a becoming. Not even the change A-to-B is a becoming. The reading arrives at a rather non-processual view of Heraclitus. Alternatively, one may want to construct the process as a period in which A obtains, a period in which the becoming of B obtains, a period in which B obtains. Even in this scenario, for A and B not to co-occur, we have to insert a sudden death of A before the becoming of B obtains. The discontinuity will also occur.

⁸⁶ The material origin fits what we expect from an Ionian presocratic. See, for instance, the constitutive model of explanation attributed to them by Moravcsik (1993).

conception fits the twisted use of the internal accusative in B62 to describe the living the death and dying the life as co-occurrent opposite processes. Accordingly, a really dynamic reading of the elemental transformations in B36 seems to favour the occurrence of objective contradictions. The conclusion should not diminish the merits of Heraclitus' worldview uninteresting. The ongoing discussion of inconsistency and change in the philosophical literature confirms that it is not easy to make sense of continuous change without accepting that different states will somehow co-exist at a shared limit.⁸⁷ Thus, instead of explaining away the role of contradiction in Heraclitus' worldview, trying to understand it might be worth the effort.

Conclusion

The investigation was structured on the assumption that Heraclitus is part of Aristotle's target as the latter addresses the Natural Philosophers whose physical investigations lead to the acceptance of some version of objective contradiction. In the discussion, Aristotle proposes a reconstruction of the Natural Philosophers' reasoning. All the proposed assumptions suit what one finds in Heraclitus' fragments, in particular the claim that the Natural Philosophers invoke change between opposites as the main source of evidence for their worldviews. The conclusion of Aristotle's reconstruction, in which there is the postulation of a state of objective contradiction, proved to be trickier. However, the examination of Aristotle's views on change revealed how, for him, the acceptance of change of change leads to a state of contradiction in a dynamic scenario. Furthermore, Heraclitus' B8, cited by Aristotle, indicates that Aristotle read Heraclitus as someone who puts a change as the origin of another change. If so, Heraclitus' view would imply a dynamic objective contradiction. Finally, based on Heraclitus' preference for a paradox such as the use of the anti-cognate on 'living the death and dying the life' (B67), I argued that he was aware of the implication. Even if Aristotle's reading is not far from what we find in the fragments, he does not seem to have been able to grasp the potential of Heraclitus' insights, in particular those concerning change. There remains a lot to be done in assessing the Heraclitean worldview, but we should not start explaining away the occurrence of objective contradictions.

⁸⁷ See Mortensen (2020).

Bibliography

- Ackrill, J. L., transl. and comm. (1975): *Aristotle's Categories and De Interpretatione*, Oxford: Oxford University Press.
- Barnes, J. (1982): *The Presocratic Philosophers*. London: Routledge.
- Begley, K. (2020): "Heraclitus' Rebuke of Polymathy: A Core Element in the Reflectiveness of His Thought", *History of Philosophy & Logical Analysis* 23, pp. 21–50.
- Betegh, G. (2007): "On the physical aspect of Heraclitus' psychology," *Phronesis* 52, pp. 3–32.
- Bickhard, M. (2009): "The Interactivist Model", *Synthese* 166, pp. 547–591.
- Bogen, J. (1992): "Change and Contrariety in Aristotle", *Phronesis* 37, pp. 1–21.
- Burnyeat, M. (1979): "Conflicting Appearances", *Proceedings of the British Academy*, 65, pp. 69–111.
- Cornford, F. M. (1930): "Anaxagoras' Theory of Matter", *Classical Quarterly* 24, pp. 14–30, 83–95.
- Curd, P. (2004): *The Legacy of Parmenides: Eleatic Monism and Later Presocratic Thought*, Zurich – Las Vegas: Parmenides Publishing.
- Curd, P. (2007): *Anaxagoras of Clazomenae: Fragments and Testimonia*, Toronto: University of Toronto Press.
- Dancy, J. (1975): *Sense and Contradiction in Aristotle*, Dordrecht: Reidel.
- Dilcher, R. (1994): "On the Wording of Heraclitus, Fragment 126", *The Classical Quarterly* 44, pp. 276–277.
- Dilcher, R. (1995): *Studies in Heraclitus*. Hildesheim: Georg Olms.
- Emlyn-Jones, C. (1976): "Heraclitus and the Unity of Opposites", *Phronesis* 21, pp. 89–114.
- Fine, G. (2003): *Plato on Knowledge and Forms: Selected Essays*, Oxford: Oxford University Press.
- Gill, M. (2004): "Aristotle's Distinction between Change and Activity", *Axiomathes* 14, pp. 3–22.
- Graham, D. W. (2006): *Explaining the Cosmos: The Ionian Tradition of Scientific Philosophy*. Princeton: Princeton University Press.
- Granger, H. (2004): "Heraclitus' Quarrel with Polymathy and "Historiê"". *Transactions of the American Philological Association* 134, pp. 235–261.
- Hegel, G. (1969): *Hegel's Science of Logic* (tr. A. Miller). London: Allen and Unwin.
- Kahn, C. (1979): *The Art and Thought of Heraclitus*. Cambridge: Cambridge University Press.
- Kirk, G. S. (1951): "Natural Change in Heraclitus", *Mind* 60, pp. 35–42.
- Laks, A. and Most, G. eds. (2016): *Early Greek Philosophy*, volume III: Early Ionian Thinkers, Part 2. Cambridge, Mass: Harvard University Press.
- Lee, M. (2005): *Epistemology after Protagoras: Responses to Relativism in Plato, Aristotle and Democritus*. Oxford: Oxford University Press.
- Leshner, J. H. (1994): "The Emergence of Philosophical Interest in Cognition", *Oxford Studies in Ancient Philosophy* 12, pp. 1–34.
- Lukasiewicz, J. (1971): "On the Principle of Contradiction in Aristotle" (tr. V. Wedin), *The Review of Metaphysics* 24 (3), pp. 485–509.
- Marcovich, M. (2001): *Heraclitus: Greek text with a short commentary*. Sankt Augustin: Akademie Verlag.
- Mortensen, C. (2020): "Change and Inconsistency", *The Stanford Encyclopedia of Philosophy*, E. N. Zalta (ed.), URL = <<https://plato.stanford.edu/archives/spr2020/entries/change/>>.
- Mourelatos, A. P. D. (1981): "Pre-Socratic Origins of the Principle that There are No Origins from Nothing", *The Journal of Philosophy*, 78, pp. 649–665.

- Mourelatos, A. (2008): *The Route of Parmenides: Revised and Expanded Edition*. Zurich-Las Vegas: Parmenides Press.
- Neels, R. (2018): "Elements and Opposites in Heraclitus", *Apeiron* 51, pp. 1–26.
- Pelletier, J. (1979): *Mass Terms: Some Philosophical Problems*. Dordrecht: Springer.
- Pradeau, J. (2002): *Héraclite, Fragments. Citations et témoignages*. Paris: Flammarion.
- Priest, G. (2006): *In Contradiction*. Oxford: Oxford University Press.
- Rapp, C. (2007): *Vorsokratiker*. Munich: C.H. Beck.
- Rapp, C. (2017): "His Dearest Enemy. Heraclitus in the Aristotelian Oeuvre". In: Fantino, E; Muss, U; Schubert, C; Sier, K; (eds.): *Heraklit im Kontext* (Studia praesocratica, 8). Berlin; De Gruyter.
- Reeve, C. (1982): "Ekpyrosis and the Priority of Fire in Heraclitus", *Phronesis* 27, pp. 299–305.
- Reeve, C. transl. (2006): Aristotle *Metaphysics*. Indianapolis: Hackett Publishing.
- Robinson, T. M. (1991): *Heraclitus: Fragments*. Toronto: University of Toronto Press.
- Ross, W. D. (1936): *Aristotle's Physics*. Oxford: Oxford University Press.
- Sattler, B. (2020): *The Concept of Motion in Ancient Greek Thought: Foundations in Logic, Method, and Mathematics*. Cambridge: Cambridge University Press.
- Seibt, J. (2004): General Processes – A Study in Ontological Category Construction, Habilitationsschrift at the University of Konstanz, Germany.
- Sorabji, R. (1976): "Aristotle on the Instant of Change", *Proceedings of the Aristotelian Society*, Supplementary Volume 50, pp. 69–89.
- Stokes, M. (1971): *One and Many in Presocratic Philosophy*. Washington: Center for Hellenic Studies.
- Tredennick, H. transl. (1989): Aristotle *Metaphysics*. Cambridge, Mass: Harvard: University Press.
- Verdenius, W. (1966): "Der Logos Begriff bei Heraklit und Parmenides", *Phronesis* 11, pp. 81–98.
- Vlastos, G. (1950) "The Physical Theory of Anaxagoras", *Philosophical Review* 59, pp. 31–57.
- Von Wright, G.H. (1968): *Time, Change and Contradiction*. Cambridge: Cambridge University Press.
- Wiggins, D. (2001): *Sameness and Substance Renewed*. Cambridge: Cambridge University Press.
- Wedin, M. (2004): "On the Use and Abuse of Non-Contradiction: Aristotle's Critique of Protagoras and Heraclitus in *Metaphysics* Gamma 5", *Oxford Studies in Ancient Philosophy* 26, pp. 213–239.